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# **BATTERY MAINTENANCE MANAGEMENT PROGRAM**

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**Presented by:**  
**PulseTech Products Corporation**  
**Mark Abelson**  
**800-580-7554, ext. 167**  
**817-307-5603 (cell)**  
[mabelson@pulsetech.net](mailto:mabelson@pulsetech.net)  
[www.pulsetech.net](http://www.pulsetech.net)

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## **Course Outline:**

- I. Introduction**
- II. Conventional battery design**
- III. AGM battery design**
- IV. Basic battery facts**
- V. Battery safety**
- VI. Common causes of battery failure**
- VII. Battery maintenance/management plan**
  - Diagnostics**
  - Corrective maintenance**
  - Preventive maintenance**
- VIII. Conclusion**
- IX. Appendix and supplemental information**

## I. Introduction

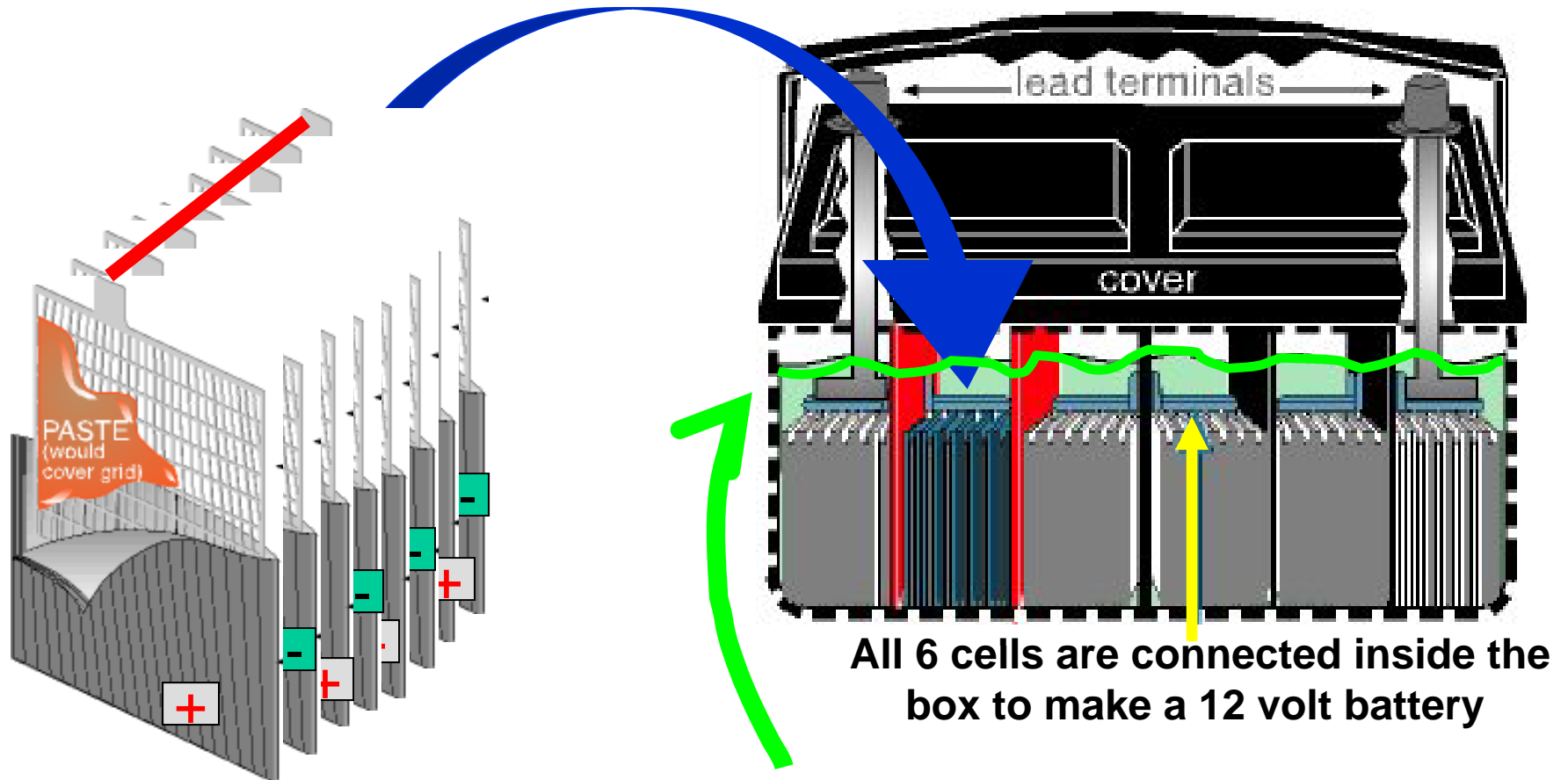
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**87,000 batteries in Kuwait**



## II. Conventional battery design



**(+) and (-) plates are connected to make a 2 volt cell.**

**All 6 cells are connected inside the box to make a 12 volt battery**

**The case is filled with electrolyte (sulfuric acid & water)**

**Electrolyte must always cover the battery plates (but don't fill to top).**

## II. Conventional battery design

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### **Conventional style batteries in use by the US Military:**

#### **6TL, 6TLFP, 6TMF, 4HN, 2HN and other commercially available batteries**

All of these batteries are flooded (“wet”) cell lead acid batteries. Though they appear similar they have different chemistry, capacities and voltages.

#### **6TMF**

**The current battery provided by military supply.**

**Brown case with a black top.**

**It is also a lead calcium plate chemistry.**

**Built-in hydrometer (a green eye).**

Note: The green eye only allows you to look at one cell in the battery and as such is not a reliable indication of overall battery condition. That is why the “eye” can indicate a battery is good but it still doesn’t perform properly.

## II. Conventional battery design

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### Conventional style batteries in use by the US Military:

#### 6TL, 4HN, 2HN

- Use lead antimony plates, many are still in the government system.
- Vary in size and voltage.
- 2HN, 12 volt. Used in small generators, i.e. the 5kW
- 4HN battery is a 24-volt battery. Use PulseTech Pro HD 12/24V auto sensing charger.

#### 6 TLFP

- This was an interim battery until the 6TMF was fielded.
- Black top and lead calcium chemistry plates.
- Produced and shipped overseas as a dry battery with an acid over-pack.

### III. AGM battery design

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### III. AGM battery design

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#### COMPARISON OF BATTERY SPECIFICATIONS 6TMF LEAD-CALCIUM vs. HAWKER AGM SEALED RECOMBINANT BATTERIES

##### MILITARY LEAD-CALCIUM BATTERIES

- 12 volts
- **CCA – 650**
- **Reserve Capacity – 200 minutes**
- Amp-hours (C/20) – **120**
- **Usable Reserve – 30% DOD**
- Shelf life – 2-3 months
- Type Battery – SLI
- Cycle Life – Unknown
- Life (cradle-grave) – 13 months
- Technology – lead-calcium flooded
- Internal resistance – 0.009 ohms
- Resistance to shock – poor
- **Transport Class – wet battery (hazardous)**
- **Environmental designation – “hazardous”**
- **Weight – 75 pounds (34kg)**
- Size (NATO 6T) - 10” (256mm) x 10.5” (269mm) x 8.9”h (227mm)

##### HAWKER AGM SEALED BATTERIES

- 12 volts
- **CCA – 1225**
- **Reserve Capacity – 240 minutes**
- Amp-hours (C/20) – **120**
- **Usable Reserve – 70% DOD**
- Shelf life – 30 months @ 25°C
- Type Battery – SLI, Deep Cycle
- Cycle Life – 400~ @ 100% DOD
- Life (cradle-grave) – 36/60 months
- Technology – AGM, sealed, recombinant
- Internal resistance – 0.0017 ohms
- Resistance to shock – excellent
- **Transport Class – non-spillable, can ship by air or other commercial transport**
- **Environmental designation – “non-hazardous”**
- **Weight – 88 pounds (40kg)**
- Size (NATO 6T) - 10” (256mm) x 10.5” (269mm) x 8.9”h (227mm)

### III. AGM battery design

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#### Same basic design as conventional battery, except:

- AGM batteries use an Absorbent Glass Mat to contain all the electrolyte.
  - The AGM holds all the electrolyte like a “super sponge”. Battery won’t leak or spill even if tipped over or accidentally cracked.
- Contains a one way safety valve to prevent out-gassing & loss of liquid during normal operation.
- High purity lead (not recycled) plus a little tin
- Plates are compressed into cell partition
  - Prevents plate to plate movement & shorting
  - Prevents loss of active paste material
  - Increases vibration resistance.

### III. AGM battery design

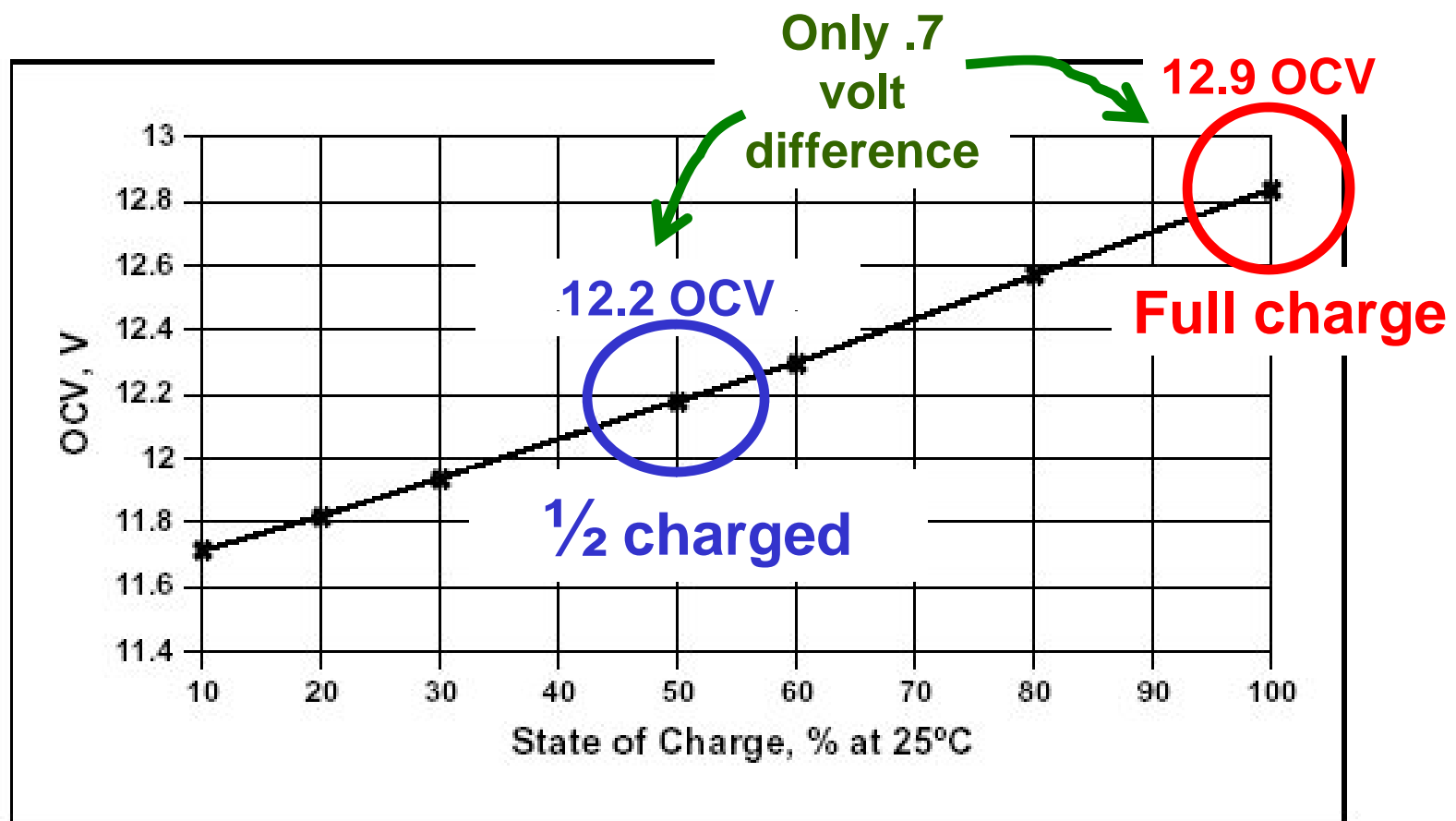
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#### Advantages of AGM batteries:

- **Longer life**
- **Less maintenance**
- **Safer**
  - No leaking acid
  - Eliminates corrosion to terminals & battery trays
  - No holes in your clothes, or burning skin
  - Reduced chance of battery explosion
- **Battery will work temporarily after cracked open or taking a round.**
- **Lower internal resistance**
  - Higher cranking power
  - More usable reserve capacity
  - Faster recharge

## IV. Basic battery facts

### A little voltage means a lot!



Hawker/Optima state of charge versus OCV

## IV. Basic battery facts

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**All batteries discharge when not being used.  
("self discharge" or "shelf life")**

**The rate of self discharge increases as the temperature goes up**

**For every 10°C rise in temperature  
the self discharge rate doubles!**

## IV. Basic battery facts



Where are your batteries?



# Battery Safety

**THIS PROGRAM DOES NOT TAKE PRECEDENCE OVER  
ANY MILITARY DIRECTIVE GOVERNING SAFETY.**

Safety information provided by  
Battery Council International (BCI)

## V. Battery Safety

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### Suggested Safety Equipment:

- Always wear proper eye, face, and hand protection.
- Keep all sparks, flames and cigarettes away from the battery.
- Never try to open a battery with non-removable vents.
- Keep vents tight and level except when servicing electrolyte.
- Make sure work area is well vented.
- Never lean over a battery when boosting, testing or charging.
- Exercise caution when working with metallic tools or conductors to prevent short circuits and sparks.

## V. Battery Safety

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### Safe Charging:

- Follow all safety practices described previously.
- Never attempt to charge a battery without first reviewing the instructions for the charger being used.
- Turn chargers off before connecting leads to the battery to avoid dangerous sparks.
- Never try to charge a frozen or visibly damaged battery.
- Connect the charger leads to the appropriate battery terminals (red to positive and black to negative)

**(This class deals only with batteries removed from the vehicle, so charging batteries when they are installed in vehicles will not be covered.)**

## V. Battery Safety

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### Handling Battery Acid:

- Battery acid or electrolyte is a solution of sulfuric acid and water that can destroy clothing and burn the skin.
- Use extreme caution when handling electrolyte and keep an acid neutralizing solution - such as baking soda or household ammonia mixed with water - readily available.
- When handling batteries or acid:
  - **Always wear proper eye, face and hand protection.**
  - **If electrolyte is splashed into an eye, immediately force the eye open and flood it with clean, cool water for at least 15 minutes. Get prompt medical attention.**
  - **If electrolyte is taken internally, drink large quantities of water or milk. DO NOT induce vomiting. Get prompt medical attention.**

## V. Battery Safety

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### Handling Battery Acid (continued):

- When handling batteries or acid:
  - Neutralize with baking soda any electrolyte that spills on a vehicle or a work area. After neutralizing, rinse contaminated area clean with water.
  - If premixed electrolyte is not available and water and sulfuric acid must be mixed:
    - **ALWAYS POUR THE CONCENTRATED ACID SLOWLY INTO THE WATER. NEVER POUR WATER INTO THE ACID.**
    - Always stir the water while adding acid. If noticeable heat develops, allow solution to cool before continuing to add the acid.

# Common causes of battery failure

## VI. Common causes of battery failure

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### Deficit charging:

- When the vehicle cannot fully charge the battery during normal operation. Results in a decline in capacity (shorter run time of electronics) and reduced battery life.

Typical causes are:

- Engine alternator voltage and/or amperage is too low,
- Engine run time not long enough to recharge batteries.
- High accessory loads (lights, radios, etc)

### Solutions:

- Install a higher amperage alternator
- Shut off accessories when possible (or leave engine running)
- Periodically use an external charger to fully charge the batteries.

## VI. Common causes of battery failure

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### Mixing different types of batteries together

Connecting different types of batteries together in the vehicle will lead to shorter battery pack life and possible overcharge or undercharge problems with individual batteries. Premature failure WILL happen.

#### Solution:

- Only connect together batteries of identical make and model.
- NEVER mix different battery types.

## VI. Common causes of battery failure

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### **Leaving (parking vehicle) batteries in a discharged condition:**

Even a partial discharge will cause sulfation on the plates that reduces battery capacity and leads to premature battery failure.

**Do not leave batteries discharged!**

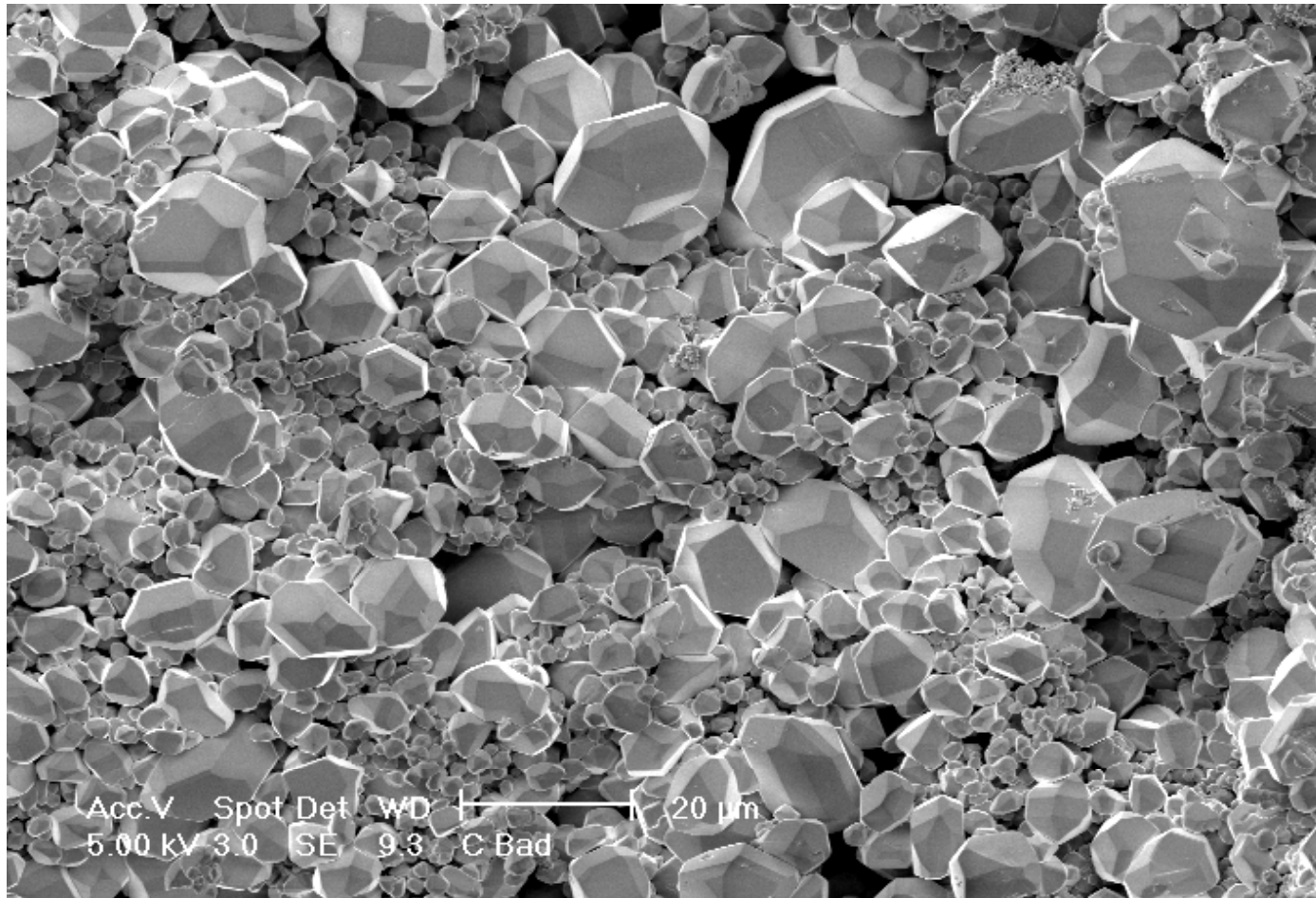
**Damage can occur in a very short period.**

#### **Solution:**

- Check batteries before storing vehicle & recharge batteries if needed.
- If the vehicle or equipment is not used on a regular basis, periodically check the battery OCV and charge when necessary.
- Charge whenever the battery OCV is:
  - Wet/flooded: 12.5 or less
  - AGM: 12.7 or less
- When storing vehicles that have on-board electronics use a maintenance charger such as those provided by PulseTech Products to prevent reoccurring battery discharge.

## VI. Common causes of battery failure - plate sulfation

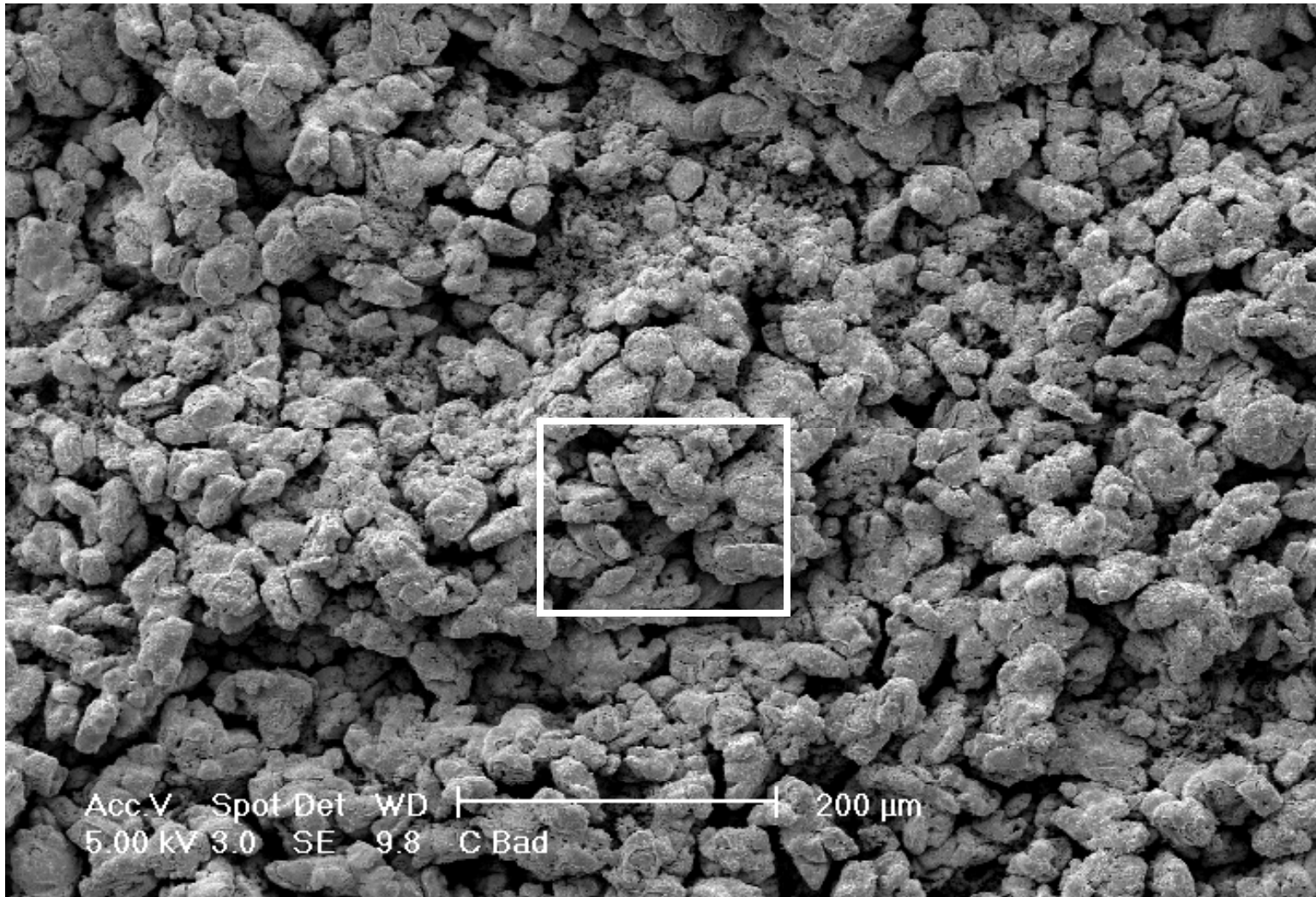
Ohio State University  
5-year old fully charged batteries



**Cathode crystalline structures remaining  
after charging without pulsing**

## VI. Common causes of battery failure - plate sulfation

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Cathode after charging and pulsing with Solargizer.  
Area in box is enlarged on next view.

## VI. Common causes of battery failure - plate sulfation

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Ohio State University  
5-year old fully charged batteries



Cathode after charging and pulsing with Solargizer

## VII. BMMP - Diagnostics

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If the engine starts, the battery must be good, right?

**NOT NECESSARILY!**

A borderline battery may start the engine, but fail shortly after.

## **VII. BMMP - Diagnostics**

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**If a battery does not pass the diagnostics tests, it MUST be pulled from the vehicle and sent to the shop for corrective maintenance. If you don't do this, your BMMP will not achieve it's full potential results AND vehicle operation is jeopardized.**

**Not conducting the diagnostic portion of the BMMP and ensuring your batteries are in good condition as you implement your program is one of the biggest causes for a BMMP to fail.**

**Diagnostics are an ongoing part of any Preventive maintenance program. It will ultimately reduce battery consumption and the money and man-hours expended on corrective maintenance or battery replacement.**

## VII. BMMP - Diagnostics

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Historically the three most common methods of battery testing have been:

- **Multi-meter**
- **Load tester**
- **Specific gravity tester (Duo-check).**

## VII. BMMP - Diagnostics

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**Multi-meter** – A good first glance tool to check out a battery.

**Voltage and a battery's capability to operate may have little to do with one another. This is especially true with flooded conventional batteries.**

An excellent example of this is the occasional battery that won't start a vehicle shortly after being taken off of a battery charger. When the battery is just off charge, a multi-meter will often give you a reading of over 13 volts. Yet when you try to start a vehicle or power radios, it immediately fails and the voltage drops to 12 volts or less. The battery had voltage (surface voltage) but no capacity.

**OCV readings alone on flooded batteries are not suitable for determining battery condition or capacity.**

**OCV readings are more accurate with AGM batteries.**

**AGM: OCV < 12.7 (25.4 on a 24 volt battery pack) recharge immediately.**

**Flooded: OCV < 12.5 (25.0 on a 24 volt battery pack) recharge immediately.**

## VII. BMMP - Diagnostics

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**Load Testing** – One of the most effective ways to test a battery's condition.

### A battery shop procedure

Creates a dead short across the battery's terminals with a gauge that indicates how the battery handles the load.

Battery **MUST** first be fully charged which makes load testing impractical anywhere except in a battery shop.

Load test battery per the equipment's instructions.

If tester is not automatic, set for  $\frac{1}{2}$  the battery CCA rating.  
(6TMF: 325 amps, Hawker Armasafe: 600 amps)

Discharge for 15 seconds.

To pass the test the battery voltage during load must stay above 9.6 volts

Passing batteries must be recharged again after load test.

## VII. BMMP - Diagnostics

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### Load Testing

Works on both Flooded & AGM batteries

OK for battery shop. Impractical in the field.

Use of Load testers takes time and requires caution.

Enormous heat and mishandling can cause burns.

Tester must be allowed to cool after every couple of batteries.

It is a time-consuming process that presents some genuine training and safety issues to users.

## VII. BMMP - Diagnostics

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### Specific Gravity Testers (Duo-check)

- In the past, Specific Gravity Testers were considered to be the standard for testing military batteries.

Can identify state of charge and bad cells.

Requires that each battery cap must be opened individually and each cell must be tested individually.

**Associated safety issues** from exposure to battery acid  
(ruined uniforms, chemical burns, etc.)

**Time consuming** - opening and closing each cap on a 5-ton truck means that at a minimum, properly testing four truck batteries will take over 30 minutes per truck. At today's manning levels, that is too many man-hours.

**(Specific Gravity tests are not applicable to sealed AGM batteries)**

## VII. BMMP - Diagnostics

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**So how do you quickly, safely and efficiently test batteries?**

**CONDUCTANCE TESTING -** Excellent snapshot of a battery's condition.

Conductance testing is performed with the **490 PT**. It's easy to use and it can test all four batteries on a truck in about 90 seconds.

The battery does not have to be fully charged, but it does need to be over 1.0 volt.

The 490 PT can be used repeatedly without heating up, opening caps or dealing with sulfuric acid.

## VII. BMMP - Diagnostics

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### CONDUCTANCE TESTING -

Uses an algorithm to compare the battery's available capacity to a known standard.

**The PulseTech 490 PT provides the operator with a digital read-out that displays**

- > Cold Cranking Amps (CCA)
- > Whether the battery needs to be recharged and re-tested
- > If it has a bad cell
- > OCV

Conductance testing is the fastest, most efficient way to test battery condition available at this time.

## VII. BMMP - Diagnostics

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### 490 PT and MBT-1

Part Nos. 741x490 and 741x800

(NSNs: 6130-01-510-9594 and 6130-01-463-8499)



## VII. BMMP - Corrective Maintenance

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**Corrective maintenance is intended to reverse or correct a problem that has already occurred.**

**You found a dead or questionable battery,  
what's the next step?**

**The first question that must be asked  
when batteries are dead is**

**“Why?”**

## VII. BMMP - Corrective Maintenance

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- **Run switch, lights or other electrical devices left on**
- **Short engine run times**  
("can't refill the bucket" without running the engine longer)
- **Key off loads**  
(loads that are still drawing current from the batteries even with the switch in the off position) newer vehicles have many microprocessors that often add to this problem.
- **Parasitic drain**  
Small shorts in the wires of one or more pieces of equipment on the vehicle. These are generally not large loads or they would trip a fuse or breaker. They pull batteries down over time. These loads must be found and fixed. See Appendix 2 – Parasitic Loads for how to test to see if you have this problem

## VII. BMMP - Preventive Maintenance

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### Lack of use or - Battery Self Discharge

- **The 6TL has a 4.4% self-discharge rate per month**  
(as identified by the USMC AVTB, Report, dated 20 March 00).
- **The Hawker Armasafe has monthly self-discharge rate of about 1%**
- **Batteries will self-discharge faster in higher temperatures.**
- **Discharged & partially discharged batteries will suffer from plate sulfation.**
- **Often a standard charger or alternator cannot break up sulfation and fully recharge the battery.**
- **The only way to prevent self-discharge & sulfation is with frequent charging or by adding hardware.**

## **VII. BMMP - Preventive Maintenance**

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### **Corrosion**

#### **Flooded Cell Batteries**

- Corrode at the posts.
- Grease or corrosion inhibiting spray properly applied delays but doesn't eliminate corrosion.
- Acid, vented at the caps, induces battery box corrosion.

#### **AGM Batteries**

- Do not produce terminal or vent cap corrosion under normal circumstances.

## VII. BMMP - Preventive Maintenance

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### Corrosion



## **VII. BMMP - Preventive Maintenance**

### **Corrosion**

#### **Improperly Treated**



Corrosion Spray – Top View



Corrosion Spray – Bottom View

#### **Properly Treated**



Battery Post Properly Treated



Battery Post Properly Treated and Prepped

## **VII. BMMP - Preventive Maintenance**

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### **AGM – Unnecessary Treatment**



## **VII. BMMP - Preventive Maintenance**

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### **Flooded Cell - Required Corrosion Control**



## VII. BMMP - Corrective Maintenance

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- Acid on the outside of the battery case



Place one probe of a multi-meter (set to DC volts) on either post of a battery and place the other probe on the “non-conductive” plastic case. With a dirty, shiny, or oily top (acid film), you will often see voltage on the meter. That means that the debris on the case has created an electric path and is drawing the battery down. To stop this, the case must be washed with soap and water to remove the oil. Baking soda must also be used to neutralize the acid (DO not allow baking soda to get into the battery cells). They can all be mixed together to make it easier.

## **VII. BMMP - Corrective Maintenance**

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**Once you have identified and hopefully corrected the cause of the problem -**

**The dead batteries are sent to the battery shop for testing and attempted recovery.**

## **VII. BMMP - Corrective Maintenance**

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**Battery corrective maintenance must recover batteries to their rated CCA level or they are not worth trying to keep in service!**

**If not sufficiently recovered,  
replace them with known good batteries!**

## VII. BMMP - Corrective Maintenance

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**Chargers** - Must be designed for the specific battery type!

**Flooded lead acid batteries use conventional automotive type chargers.**

When possible the charger should be an automatic type as to not accidentally overcharge the battery if it's left connected.

**AGM batteries need a high quality charger**

Voltage needs to be properly controlled  
(some automotive chargers can have a very wide voltage swing)

**If it does NOT have an AGM or sealed battery setting:  
Voltage should be regulated between 14.25 and 14.9 volts.**

**All Chargers should be built for rough treatment:**

Heavy Duty power supply  
Tough clamps for good electrical connection.

## VII. BMMP - Corrective Maintenance

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**Pulse Chargers** – The Pulse Charger/World Version PLUS is four products in one.

- 110-volt & 220-volt switch for use within the United States or abroad.
- Switch (on back) for unique requirements of flooded lead-acid batteries and AGM or Gel Cell batteries.
- There is a Pulse Only setting designed to pulse clean the battery internally.
- Pulse & Charge, which simultaneously pulses the battery while it is being charged.

It's also a 20 amp “smart” charger that constantly tests the battery to insure a proper charge. Once the battery is fully charged, the unit switches to Pulse Only to maintain the battery.

***(Note: The Pulse Charger incorporates a safety feature that prevents it from starting its charge regimen if a battery is below approximately 6 volts. Batteries below 6 volts can seldom be recovered, however by charging a known mechanically sound battery at low amperage for an hour you can get the Pulse Charger to activate though this is not recommended for safety reasons.)***

## VII. BMMP - Corrective Maintenance

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### Pulse Chargers

- The Pro HD is a “smart charger” for use on both 12- and 24-volt systems.
- Fully automatic smart charger senses battery condition and provides only what the battery can accept.
- Charges all conventional lead-acid battery types (flooded cell and AGM).
- Smart technology and pulsing prevents battery gassing and allows charging in the vehicle.
- 40-amp DC output in 12- or 24-volt mode (automatically switches between 12- and 24-volt systems).

***Adjusts charge voltage and current to maximize battery recovery and charging. Smart technology and pulsing prevents battery gassing which allows charging with batteries installed in the vehicles.***

## VII. BMMP - Corrective Maintenance

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### Pulse Chargers

- The HD Pallet Charger is for use on all 12-volt batteries
  - Senses battery condition and provides appropriate charge current per channel.
  - Charges all conventional lead-acid battery types (flooded cell, AGM & gel).
  - Smart technology and pulsing prevents battery gassing, which allows charging with batteries sitting on the pallet.
  - Batteries can be left on pallets and not handled needlessly.
  - **Very effective on deeply discharged AGM batteries that have been taken out of service in the past.**
  - Charges and conditions up to 12 batteries at a time.
  - Batteries no longer need to be separated by type or state-of-charge.

## VII. BMMP - Corrective Maintenance

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**HD Pallet Charger**  
Part No. 746x820  
NSN: 6130-01-532-7711



**Redi-Pulse Pro HD**  
Part No. 746x800  
NSN: 6130-01-500-3401



**MBT-1**  
Part No. 741x800  
NSN: 6130-01-463-8499



**490PT**  
Part No. 741x490  
NSN: 6130-01-510-9594



**Redi-Pulse Pro-12**  
Part No. 746x912  
NSN: 6130-01-535-2718

### **Battery Service Equipment Set (BSES)**

- 1 – HD Pallet Charger
- 1 – Redi-Pulse Pro-HD 12/24V Charger
- 1 – Redi-Pulse Pro-12
- 10 – MBT-1 Battery Testers
- 1 – 490PT Battery Analyzer

*“Initially we didn’t think it was going to be anything other than additional charging stations, but immediately we found that we could recover twice as many batteries using the technology incorporated into the BATTCAVE Chargers.”*

*DOL – Fort Lewis*

## **VII. BMMP - Corrective Maintenance**

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### **Pulse Charger/World Version**

**Part No. 746x725**

**NSN: 6130-01-477-4703**

This is a 110/220V charging system that works with both 12V conventional flooded lead-acid batteries and sealed “maintenance-free” batteries, including Valve Regulated Lead-Acid (VRLA), Absorbed Glass Mat (AGM) and gel cell.

## **VII. BMMP - Corrective Maintenance**

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### **HD Jump Start, Part No. 746x700, NSN: 6130-01-564-9082**

The Jump Start has a built-in charger and when left plugged into an AC source, the charger will maintain the batteries at 100% efficiency. When charging, the charger lights will be yellow. This gear is virtually maintenance-free, user-friendly, rugged and field serviceable.

## VII. BMMP - Corrective Maintenance

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### Products included, but not limited to:

- 8 - Pulse Charger/World Version
- 2 – 490PT Battery Analyzers
- 1 - Redi-Pulse Pro-12
- 10 - MBT-1 Load Tester
- 1 – Redi-Pulse Pro-HD 12/24-volt
- 1 – Multi-fuel capable generator



### Commercial Mobile Battery Shop (CONUS and OCONUS)

Part Nos. 740x905 and 740x906

NSNs: 6130-01-526-9085 and 6130-01-527-3846

*“The BATTCAVE was a lifesaver in Afghanistan. We were at the end of a very long logistics system. Were it not for the BATTCAVE, battery maintenance would not have existed in country. Many thanks for all of your assistance.”*

- CW4 Roy Johnson  
DMMC, 10<sup>th</sup> DISCOM  
Ft. Drum, NY

## **VII. BMMP - Preventive Maintenance**

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### **Preventive Maintenance**

**After diagnosis and correction of your battery's condition, the batteries are reinstalled in the vehicles and equipment.**

**PM also includes checking and charging batteries prior to installation. It is very common to get “new” batteries that have been sitting idle for months prior to your purchasing them. Not starting with a fully charged battery will reduce the battery's life.**

## VII. BMMP - Preventive Maintenance

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**Ignored batteries will soon be right back to their start point.**

**PM is an action to prevent a problem from occurring or reoccurring.**

**Some PM actions are easy and cost nothing but time, others take more work and have a dollar value assigned to them.**

**During PM batteries will often be found to be dead or in a low state of charge (this is where the ongoing diagnostic cycle is most evident).**

**As discussed before, remember the common causes of discharged & failed batteries:**

## VII. BMMP - Preventive Maintenance

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Common causes discussed previously:

- Dirty battery cases
- Parasitic loads
- Key off discharge
- Operator error (lights & switches left on)
- Self Discharge
- Insufficient engine run time

## **VII. BMMP - Preventive Maintenance**

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### **PM equipment:**

**Solar Charging Systems** – Battery maintenance devices used on vehicles to prevent and break up large crystal sulfates on battery plates which occur in discharged batteries.

Sulfate crystal formations slowly destroy the battery's capacity.

Solar charge systems can be powered by either sunlight (Solar panel) or an AC receptacle.

Older model solar maintenance systems offset the 6TL's self-discharge from 4.4% to .8% per month.

New solar charge systems maintain and/or charge battery systems.

## VII. BMMP - Preventive Maintenance

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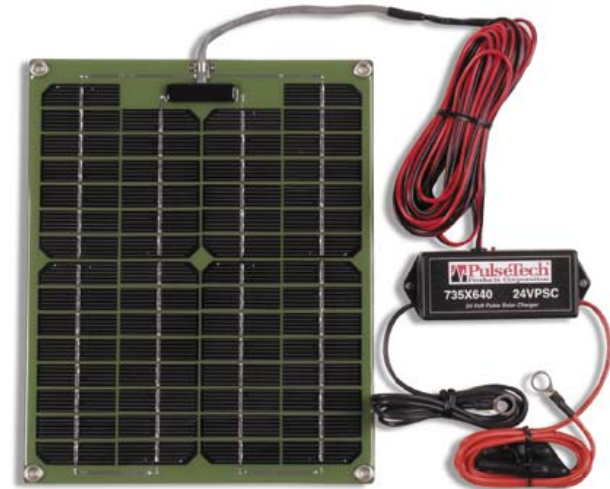
### PM equipment:



**24-volt Pulse Charge Monitor System**

**Part No. 735x643**

**NSN: 6130-01-497-0964**



**24-volt Pulse Solar Charger**

**Part No. 735x640**

**NSN: 6130-01-487-0035**

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## **How can I get FREE Pulse Solar Chargers?**

- 8. Supply Action.** The PSC kit will be stocked at Marine Corps Logistics Command (LOGCOM), Albany, GA. Units requiring the PSC kit can request the kit by contacting Inventory Manager, Code 583-1, DSN 567-7890, COMM (229) 639-7890, or the equipment specialist at DSN 567-7563, Comm. (229) 639-7563.

Using unit funding, using units may also obtain the PSC by ordering NSN 6130-01-487-0035. The PSC kit will be supplied with new generators fielded in FY06 and later.

Or contact Mr. Mike Bissonnette at PM EPS at (703) 621-3282

Generator MI's

MI 6115-OR/31	MEP-805A/B and MEP-815A/B
MI 6115-OR/32	MEP-806A/B and MEP-816A/B
MI 09247A/09248A-OR/1	MEP-803A and MEP813A
MI10155A-OR/1	MEP-831A
MI 11125A-OR/1	USMC 20KW (MMG25) 12v MAGNUM
HMMWV MI Pending Review	

## VII. BMMP - Preventive Maintenance

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### **Solar Pulse Charge Monitor System w/NATO Connector**

#### **Part No. 735x687, NSN: Pending**

- Red LED flashing indicates battery is being pulsed.
- Green LED flashing indicates battery is being charged.
- Green LED steady indicates battery is fully charged.
- Red LED steady requires checking connection or battery voltage has dropped below 22 volts.

## VII. BMMP - Preventive Maintenance

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### PM-MEP Test Summary Results for Ft. Belvoir, VA:

Test start date: April 21, 2004

Duration: 12 months

Equipment: Four generators  
(2 batteries per generator, 24 VDC)

Two generators with new Optima 800U batteries.  
(one generator with solar, one without)

Two generators with new Exide 6TMF, conventional flooded lead acid battery.  
(one generator with solar, one without)

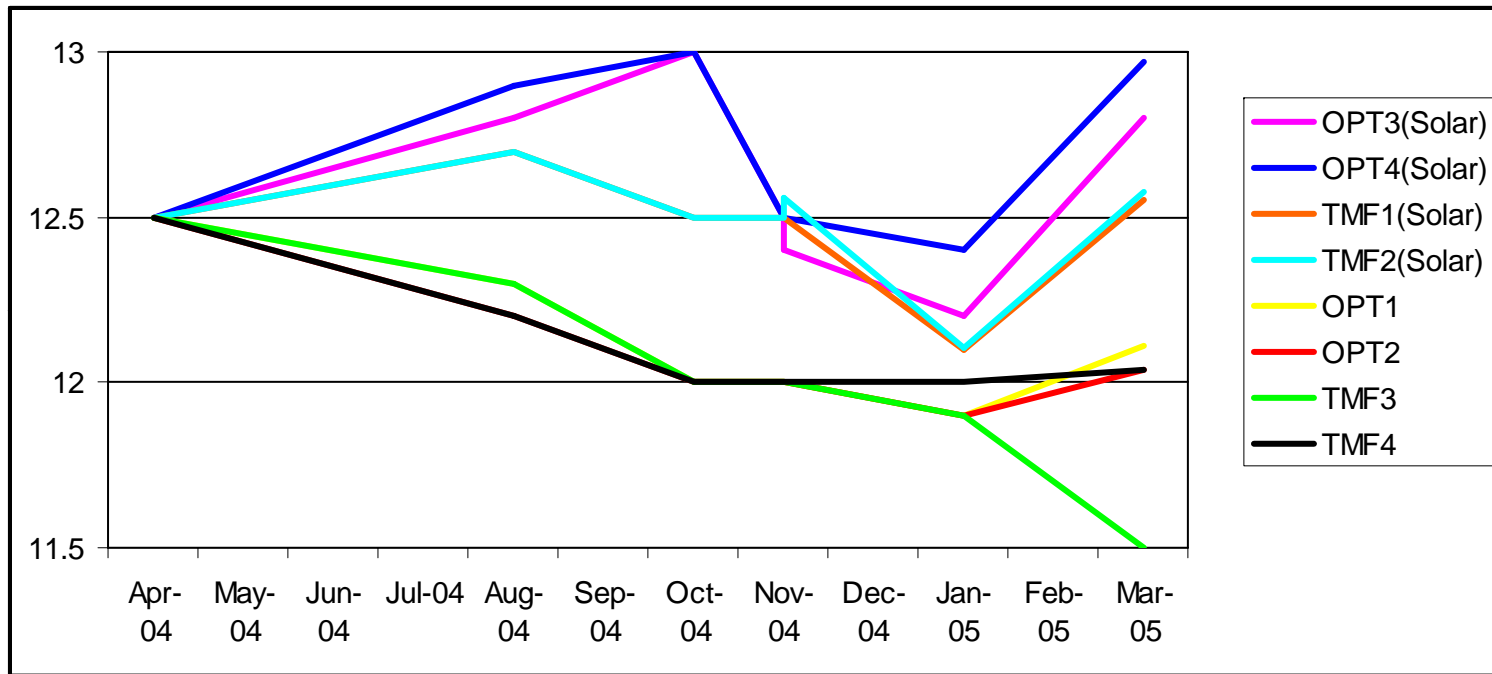
Two generators with PT Solar charger: 735X643



## VII. BMMP - Preventive Maintenance

### PM-MEP Test Summary Results for Ft. Belvoir, VA:

#### PulseTech Solar Charger (part no. 735x643)



**Conclusion:** Military generators often sit for longer periods of time not being used. Then when they are needed, it is common to find the batteries discharged and unable to start the engine.

All batteries have a defined shelf life causing them to discharge over time. Self discharge rates are higher in warm climates where the military commonly operates.

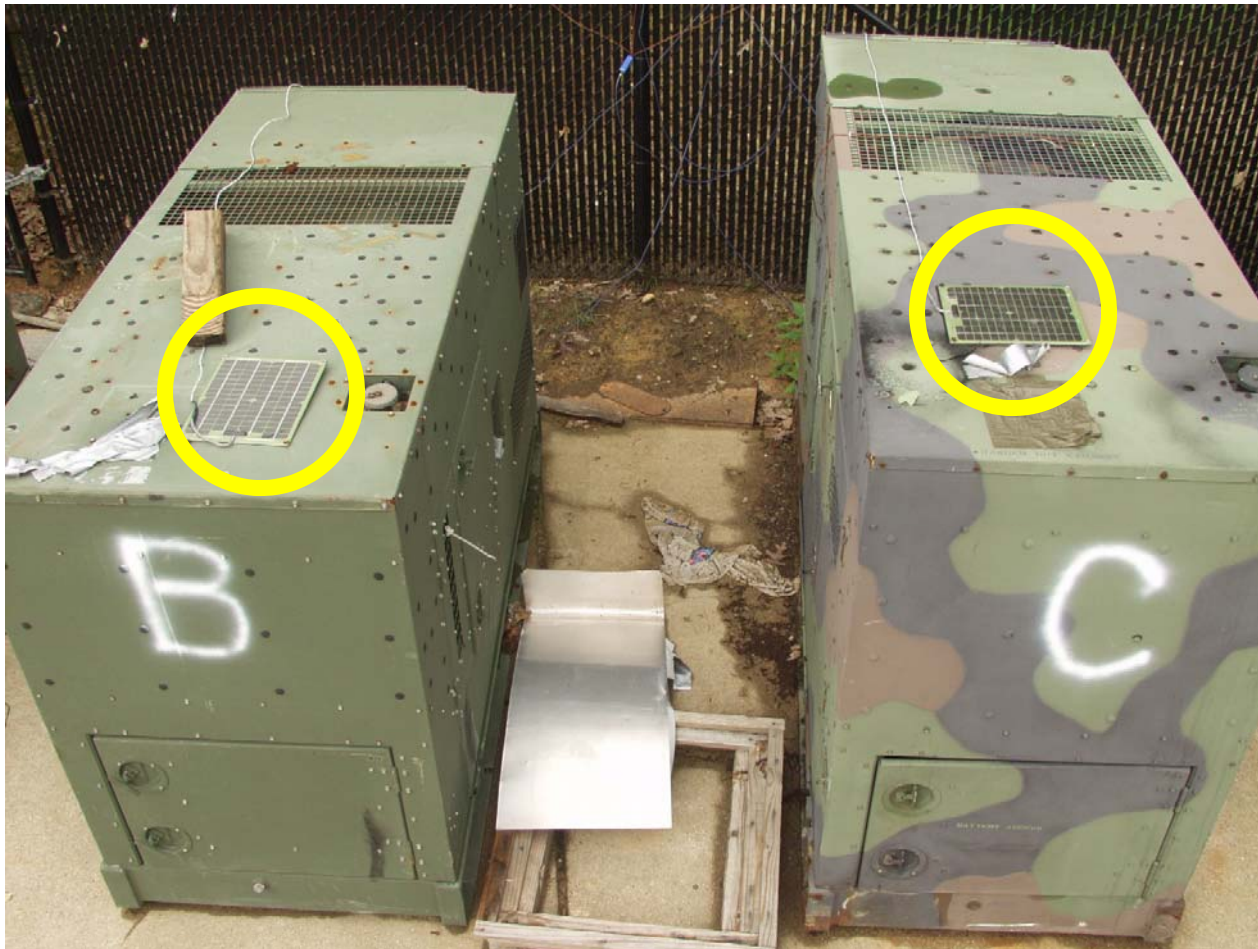
The batteries here using the solar Pulse chargers are fully charged and ready to start an engine.

The batteries without solar are over 50% discharged. It is unlikely they could start a generator.

## VII. BMMP - Preventive Maintenance

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### PM-MEP Test Summary Results for Ft. Belvoir, VA:



## VII. BMMP - Preventive Maintenance

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### PM reminders:

- Use of PM equipment described above does not eliminate the requirement of checking electrolyte levels in flooded lead acid batteries.
- PM equipment will not keep dirt and grime off the batteries; they still need to be cleaned.
- Solargizer type products will slow the self-discharge rate of a 6TL, but not overcome it. However, a Solargizer will overcome the self-discharge rate of an AGM battery.

## VII. BMMP - Preventive Maintenance

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### PM reminders:

- Check batteries on a regular basis -  
Whenever doing other PM inspections, or at a minimum every month
  - Battery connections checked and cleaned if needed.
  - Battery hold-down brackets, tighten if battery is loose.
  - Dirty batteries, clean if necessary.
  - Voltage or conductance test. Check and charge or send to battery shop if necessary.
  - Equipment with known battery problems should be checked more frequently until problem is solved.

A properly administered PM program will reduce the requirement for Corrective Maintenance and create huge savings in man-hours and money

## VIII. Conclusion

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### **Conclusion:**

**The information and maintenance practices described today will provide direct benefits in terms of:**

- **Optimal vehicle electrical system performance**
- **Lower battery related maintenance expenses**
- **Fewer dead vehicles and jump starts**
- **The longest battery life possible**

**Any final questions?**

## **IX. Appendix and supplemental information**

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### **Appendix and supplemental information**

## IX. Appendix and supplemental information

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### **Battery and Charger Frequently Asked Questions (FAQs)**

**Question:** My batteries are at 12 volts but my vehicle won't start. I must have something else wrong with my vehicle.

**Answer:** 12-volt batteries are severely discharged when they are at 12 volts as indicated in the chart below.

Double the open circuit voltage shown for 24-volt systems, the percent of charge does not change.

<b><u>Flooded Battery</u></b> <b><u>Open Circuit Voltage</u></b>	<b><u>AGM Battery</u></b> <b><u>Open Circuit Voltage</u></b>	<b><u>Percent of Charge</u></b>
<u>12.6 or greater</u>	<u>12.9 or greater</u>	<u>100%</u>
<u>12.4 – 12.6</u>	<u>12.65 – 12.9</u>	<u>75 – 100%</u>
<u>12.2 – 12.4</u>	<u>12.35 – 12.65</u>	<u>50 – 75%</u>
<u>12.0 – 12.2</u>	<u>12.1 – 12.35</u>	<u>25 – 50%</u>
<u>10.5 – 12.0</u>	<u>10.5 – 12.1</u>	<u>0 – 25%</u>

## IX. Appendix and supplemental information

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### **Battery and Charger Frequently Asked Questions (FAQs)**

**Question:** Cleaning the battery case is not really necessary unless there is a lot of acid on the top of it.

**Answer:** The tops of batteries should be washed down with a soapy water solution at least once every three months and more frequently when operating in a dusty environment. Dirt and acid residue on the top of the battery create a conductive path across the top of a battery. The path provides a means for current to leak across the top of the battery case and accelerates a battery's self-discharge. To demonstrate this for yourself, put a probe from a multi-meter on the post (positive or negative) across the top of a battery and then place the other probe on the top of the base itself (not the other post). If you get no voltage reading, the battery case is clean, if you do get a reading, you are leaking voltage across the battery case and adding to the battery's self-discharge. The leakage is only mAs, but it is continuous.

## IX. Appendix and supplemental information

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### **Battery and Charger Frequently Asked Questions (FAQs)**

**Question:** I have installed a Solargizer on my battery and my battery is overflowing now, so the Solargizer must be causing it to boil over.

**Answer:** First of all a Solargizer CANNOT overcharge a battery or cause it to boil over. It is physically impossible! The most common reason for batteries to boil over is that they are overfilled. The proper electrolyte fill level is 1/8 inch below the plastic tube in the battery (there are exceptions to this, but if you use this as a rule of thumb, your boil-over problems will be greatly reduced). Unfortunately, many maintainers/operators mistakenly think that if they fill the battery a little more, then they won't have to add water as often, nothing could be further from the truth. A water level that is too high leads to premature battery failure and accelerated acid induced corrosion in the battery box or engine compartment. If after you have verified that the electrolyte level was correct, you still have a boil-over problem then the voltage regulator/alternator may be causing the problem and the charge system output to the battery should be tested.

## IX. Appendix and supplemental information

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### **Battery and Charger Frequently Asked Questions (FAQs)**

**Question:** I am not getting enough silent watch time or my vehicle won't start even though the green eye says my battery is fully charged.

**Answer:** The green eye lies. The green eye is a hydrometer that looks at one cell in the battery to give you an indication of the battery state of charge. The problem is twofold; first, the eye only provides a window to one cell and the battery has six cells and second, the eye may be green and the battery is discharged as much as 65%. There is no way to tell using the eye as an indicator what state of charge within that 35% range, the battery is in. You are obviously not going to get 100% capacity performance when the battery is discharged.

## IX. Appendix and supplemental information

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### APPENDIX 1 PARASITIC DRAIN

#### Testing for Parasitic Drain

The procedure identified here is to establish the level of key-off parasitic drain present in your vehicles. If you don't know the level of key-off parasitic drain, the manufacturer designed into a specific vehicle or system then testing several vehicles to get an average will provide a base level to measure against. Keep in mind different variants of the same vehicle may have different base levels of key-off parasitic drain. If after establishing a baseline, you find specific vehicles that always have run-down batteries, test them as outlined below and then find out what is causing the accelerated discharge of your batteries and repair it.

Using a multi-meter with the capability to read amperage, perform the following steps:

1. Turn power off to the meter.
2. Ensure the probes are in position on the meter to read DC amperage.

## **IX. Appendix and supplemental information**

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### **APPENDIX 1** **PARASITIC DRAIN** **(continued)**

3. Break the circuit (usually this should be done at the system's ground connection at the battery). In some vehicles, breaking the circuit will cause on-board systems to lose memory and it can be quite a process to re-initiate the systems. To avoid this, prior to breaking the circuit, place a jumper wire across the circuit at the location you intend to break. Then break the circuit and proceed to step 4.
4. Connect the meter probes in series in the circuit.
5. Turn meter power on.
6. Take reading.

## PulseTech Products Product Information, GSA Contract: GS-07F-0473M

<u>Part No.</u>	<u>NSN</u>	<u>Description</u>	<u>GSA Price per Unit</u>
<a href="#"><u>741x475</u></a>	<a href="#"><u>6130-01-462-6840</u></a>	<a href="#"><u>475 Battery Analyzer</u></a>	<a href="#"><u>\$428.91</u></a>
<a href="#"><u>741x490</u></a>	<a href="#"><u>6130-01-510-9594</u></a>	<a href="#"><u>490 PT Battery Analyzer</u></a>	<a href="#"><u>\$650.40</u></a>
<a href="#"><u>741x800</u></a>	<a href="#"><u>6130-01-463-8499</u></a>	<a href="#"><u>MBT-1 Battery Tester</u></a>	<a href="#"><u>\$39.90</u></a>
<a href="#"><u>746x725</u></a>	<a href="#"><u>6130-01-477-4703</u></a>	<a href="#"><u>12V Pulse Charger/World Version</u></a>	<a href="#"><u>\$554.61</u></a>
<a href="#"><u>746x800</u></a>	<a href="#"><u>6130-01-500-3401</u></a>	<a href="#"><u>12/24V Redi-Pulse Pro HD</u></a>	<a href="#"><u>\$2,992.99</u></a>
<a href="#"><u>746x820</u></a>	<a href="#"><u>6130-01-532-7711</u></a>	<a href="#"><u>HD Pallet Charger</u></a>	<a href="#"><u>\$2,744.50</u></a>
<a href="#"><u>746x100</u></a>	<a href="#"><u>6130-01-541-9731</u></a>	<a href="#"><u>Battery Service Equipment Set (BSES)</u></a>	<a href="#"><u>\$7,238.16</u></a>
<a href="#"><u>746x700</u></a>	<a href="#"><u>6130-01-564-9082</u></a>	<a href="#"><u>HD Jump Start</u></a>	<a href="#"><u>\$4,290.00</u></a>
<a href="#"><u>735x640</u></a>	<a href="#"><u>6130-01-487-0035</u></a>	<a href="#"><u>24V Pulse Solar Charger</u></a>	<a href="#"><u>\$218.46</u></a>
<a href="#"><u>735x740</u></a>	<a href="#"><u>6130-01-546-8432</u></a>	<a href="#"><u>12V Pulse Solar Charger</u></a>	<a href="#"><u>\$169.00</u></a>
<a href="#"><u>735x643</u></a>	<a href="#"><u>6130-01-497-0964</u></a>	<a href="#"><u>24V Pulse Charge Monitor System</u></a>	<a href="#"><u>\$381.47</u></a>
<a href="#"><u>746x912</u></a>	<a href="#"><u>6130-01-535-2718</u></a>	<a href="#"><u>Redi-Pulse Pro-12 Battery Maintainer</u></a>	<a href="#"><u>\$225.00</u></a>
<a href="#"><u>735x150</u></a>	<a href="#"><u>6130-01-392-8347</u></a>	<a href="#"><u>24V Solargizer</u></a>	<a href="#"><u>\$134.66</u></a>
<a href="#"><u>735x655</u></a>	<a href="#"><u>6130-01-521-1317</u></a>	<a href="#"><u>12V Pulse Charge System (PCS) with/Panel</u></a>	<a href="#"><u>\$292.50</u></a>
<a href="#"><u>735x666</u></a>	<a href="#"><u>6130-01-521-1765</u></a>	<a href="#"><u>12V Pulse Charge System (PCS) without/Panel</u></a>	<a href="#"><u>\$194.50</u></a>
<a href="#"><u>735x661</u></a>	<a href="#"><u>6130-01-521-1387</u></a>	<a href="#"><u>24V Pulse Charge System (PCS) with/Panel</u></a>	<a href="#"><u>\$319.50</u></a>
<a href="#"><u>735x667</u></a>	<a href="#"><u>6130-01-521-1329</u></a>	<a href="#"><u>24V Pulse Charge System (PCS) without/Panel</u></a>	<a href="#"><u>\$194.50</u></a>
<a href="#"><u>735x687</u></a>	<a href="#"><u>6130-01-558-5371</u></a>	<a href="#"><u>Solar Pulse Charge Monitor System w/NATO Connector</u></a>	<a href="#"><u>\$350.00</u></a>
<a href="#"><u>735x645</u></a>	<a href="#"><u>6130-01-497-0971</u></a>	<a href="#"><u>24V Drop Pulse &amp; Charge</u></a>	<a href="#"><u>\$325.00</u></a>
<a href="#"><u>735x646</u></a>	<a href="#"><u>6130-01-497-0966</u></a>	<a href="#"><u>24V Grid System</u></a>	<a href="#"><u>\$3,790.50</u></a>

### For More Information

Contact PulseTech Products at 800-580-7554

Mark Abelson, ext. 167, e-mail: [mabelson@pulsetech.net](mailto:mabelson@pulsetech.net) or

Kathy Eisenhauer, ext. 164, e-mail: [keisenhauer@pulsetech.net](mailto:keisenhauer@pulsetech.net)

or visit our website at [www.pulsetech.net](http://www.pulsetech.net)

**BATTERY MAINTENANCE MANAGEMENT PROGRAM**